

IN THE SPECIFICATION:

Please amend paragraphs [002] - [004], [008] - [011], [013] – [015], [017], [018], [020] - [025], [027] - [029], [032], [033], [035], [038], [039] and add paragraphs [001] and [040] as shown below, in which deleted terms are shown with strikethrough and added terms are shown with underscoring. Also amend the headings between paragraphs [001]-[002] and [030]-[031] as shown below.

Paragraph [001]

CROSS-REFERENCE TO RELATED APPLICATION

The present application claims priority under 35 USC §119 from Japanese Patent Application No. 2003-063560 filed 10 March 2003.

Paragraph [002]

The present invention relates to a cleaning apparatus for a slit nozzle which is used for applying a coating liquid in a ~~state of having a~~ predetermined width onto the surface of a plate-like material to be treated, such as a semiconductor wafer, a glass substrate, or the like.

Paragraph [003]

2. DESCRIPTION OF THE PRIOR BACKGROUND ART

According to the conventional art, in order to apply a resist liquid or the like to the surface of a plate-like substrate material to be treated such as a semiconductor wafer, a glass substrate, or the like, a coating liquid is dropped from a nozzle onto the center of the material to be treated which is mounted on a spinner, and the coating liquid is dispersed to the outside by centrifugal force which is generated by rotating the material to be treated with the spinner. However, in this method, only a small amount of coating liquid remains on the surface of the

material to be treated, while almost all the liquid is dissipated and wasted.

Paragraph [004]

Therefore, instead of spinner coating, a slit nozzle has been invented. The slit nozzle has an opening of a predetermined width for discharging a coating liquid, and a coating liquid is applied to the surface of the substrate material to be treated in a ~~state of having~~ a predetermined width by moving the nozzle with respect to the substrate material to be treated.

Paragraph [008]

Therefore, another method for cleaning a nozzle has been disclosed in which a plurality of scrubbers are provided, and the nozzle is cleaned by allowing the surface of the scrubbers to come into contact with the surface to be cleaned in the various positions along the outer surface of the nozzle, while the scrubbers are rotated in a cleaning liquid. Each scrubber is a brush made of bristles, and the axis is movable so as to be adapted for various kinds of nozzles. See, for example, Document 1: Japanese Patent Application Publication 2002-500097 (p38-p40, FIG. 9)

Paragraph [009]

However, the above-mentioned method has a drawback that the position of the axis needs to be changed each time the area to be cleaned is changed, because the axis of the scrubber cannot be moved during cleaning.

Paragraph [010]

The present invention has been made to solve the discussed drawback, and ~~the~~ an object of the present invention is to provide a cleaning apparatus for a nozzle comprising a brush whose axis is movable upward and downward, and also leftward and rightward while the brush is being rotated.

Paragraph [011]

According to a first aspect of the present invention, for the purpose of overcoming the drawback mentioned above, there is provided a cleaning apparatus for a nozzle having a slit-like discharge opening in the lower end thereof, comprising a cleaning tank ~~which is filled with~~ containing a cleaning liquid, and a cylindrical long-length brush which is disposed in the cleaning liquid within the cleaning tank so that the longitudinal axis of the brush is parallel to the slit-like discharge opening, wherein the length of the long-length brush is substantially the same as the length of the nozzle, and the brush is rotatable around the axis thereof and can be reciprocated in ~~the~~ a horizontal direction perpendicular to the axis and also in ~~the~~ a vertical direction.

Paragraph [013]

Regarding the arrangement direction of ~~the~~ a hair structure of the long-length brush, the hair structure is arranged obliquely with respect to the axis of the brush so as to be in contact with the lower end of the nozzle to be cleaned in an oblique direction. With this, the contact area of the hair structure with the portion of the nozzle to be cleaned becomes large, and thereby cleaning efficiency can be improved.

Paragraph [014]

According to a second aspect of the present invention, there is provided a cleaning apparatus for a nozzle having a slit-like discharge opening in the lower end thereof, comprising a cleaning tank ~~which is filled with~~ containing a cleaning liquid, and two cylindrical long-length brushes which are disposed in the cleaning liquid within the cleaning tank so that the longitudinal axes of the brushes are parallel to the slit-like discharge opening, wherein the two long-length brushes are located in ~~the~~ positions where the hair structures thereof are in contact with each other so as to sandwich the lower end of the nozzle therebetween, and wherein the length of each long-length brush is substantially the same as the length of the nozzle, and each brush is rotatable

around the axis thereof and can be reciprocated in ~~the~~ a horizontal direction perpendicular to the axis and also in ~~the~~ a vertical direction.

Paragraph [015]

Since the two long-length brushes are rotated and moved in the vertical direction and the horizontal direction in a state where the lower end of the nozzle to be cleaned is sandwiched between the two long-length brushes, it is possible to more efficiently clean both side surfaces of the discharge opening of the slit nozzle as well as the discharge opening itself with the long-length brushes always being in contact in the best positions. Specifically, in order to clean both side surfaces of the discharge opening, the long-length ~~brush is~~ brushes are moved in the horizontal direction and then elevated.

Paragraph [017]

FIGS. 1(a) – (c) are side schematic views which shows the movement of a cleaning apparatus for a nozzle according to a first embodiment of the present invention;

Paragraph [018]

FIGS. 2(a) – 2(b) are plan views which shows a cleaned area of the nozzle depending on the arrangement angle of the hair structure of the long-length brush, specifically, FIG. 2 (a) shows a case where the arrangement direction is perpendicular to the portion of the nozzle to be cleaned and FIG. 2 (b) shows a case where the arrangement direction is oblique with respect to the portion of the nozzle to be cleaned;

Paragraph [020]

FIGS. 4(a) – (c) are ~~is a~~ diagrams showing the structure of the movement of the long-length brush for cleaning a slit nozzle seen from the cross-section; and

Paragraph [021]

FIGS. 5(a) – 5(b) are side schematic views which shows a cleaning apparatus for a nozzle according to a second embodiment of the present invention.

Paragraph [022]

DETAILED DESCRIPTION OF THE ~~PREFERRED~~ PRESENT EMBODIMENTS

Hereinafter, embodiments according to the present invention will be explained with reference to the attached drawings.

Paragraph [023]

FIGS. 1 (a)-(c) show the movement of a cleaning apparatus for a nozzle according to a first embodiment of the present invention, FIGS. 2 (a) and (b) show a cleaned area of the nozzle depending on the arrangement angle of the hair structure of the long-length brush, FIG. 3 is a cross-sectional view of an example of the cleaning apparatus for a nozzle according to the first embodiment of the present invention, FIGS. 4 (a)-(c) are diagrams showing the structure of the movement of the long-length brush for cleaning a slit nozzle seen from the cross-section, and FIGS. 5(a) and (b) shows a cleaning apparatus for a nozzle according to a second embodiment of the present invention.

Paragraph [024]

As shown in FIGS. 1(a) – (c), a cylindrical long-length brush 3 is disposed to be rotatable within a cleaning tank 2 which is a reservoir for a cleaning liquid 1, and a slit nozzle 4 is positioned above the long-length brush 3 so as to be movable in the vertical direction. Incidentally, line a-a' in FIGS. 1(a) – (c) is an imaginary line for showing the reference position.

Paragraph [025]

The axis of the long-length brush 3 is parallel to a slit-like discharge opening which is located in the lower end of the slit nozzle 4. The long-length brush 3 is rotatable around ~~the~~ its axis, and also the long-length brush 3 can be reciprocated in the horizontal direction perpendicular to the axis and in the vertical direction.

Paragraph [027]

The arrangement direction of the hair structure of the long-length brush 3 is may be oblique as shown in FIG. 2 (b). By doing so, the cleaned area becomes greater compared to a case where the arrangement direction is perpendicular to the lower end of the slit nozzle to be cleaned (that is, the discharge opening and both side surfaces thereof) as shown in FIG. 2(a), and cleaning efficiency is improved. Preferably, the flow direction of the hair structure 3a of the long-length brush 3 is set to be the same as the rotation direction of the long-length brush 3.

Paragraph [028]

Also, three combs 5 as a brush cleaning means are provided in the bottom of the cleaning tank 2 as shown in FIG. 1 in order to scrape dirt and other foreign matter attached to the hair structure of the long-length brush 3. The number of combs 5 may be changed as needed, and also the material and the shape are not limited to the particular ones depicted.

Paragraph [029]

The amount of the cleaning liquid 1 can be changed freely. The whole brush 3 may be immersed into the cleaning liquid, or almost half of the long-length brush 3 may be immersed into the cleaning liquid. That is, the amount of the cleaning liquid 1 can be set optionally depending on the degree of cleaning desired.

Paragraph [032]

In addition, as shown in FIG. 3, two partition plates 20 are provided in the bottom of the cleaning tank 2, and the area surrounded by the partition plates 20 forms a reservoir portion for a cleaning liquid 21 to immerse the long-length brush 3 therein. In a case where the cleaning liquid overflows the partition plates 20, the liquid passes through drain ports 22 which are also provided in the bottom of the cleaning tank 2, and is discharged from a drain pipe 23. If needed, another drain port 22 may be provided in the bottom of the reservoir portion for a cleaning liquid 21, as indicated in broken lines, so that cleaning can be conducted to the reservoir portion for a cleaning liquid 21.

Paragraph [033]

In operation, as shown in FIG. 1(a), the long-length brush 3 is moved downward and rightward while being rotated clockwise, and thereby the left side 4a of the lower end of the silt nozzle 4 and the discharge opening 4b of the slit nozzle 4 are cleaned by the long-length brush 3 in a state where the long-length brush 3 keeps in contact with the lower end of the slit nozzle 4. Next, the long-length brush 3 is moved upward and rightward, as shown in FIGS. 1(b) and 1(c), and thereby the right side 4c of the lower end of the slit nozzle 4 is cleaned by the long-length brush 3. In the process of the above-mentioned cleaning, the combs 5 scrapes dirt and other foreign matter attached to the hair structure 3a of the long-length brush 3. Alternatively, cleaning may be conducted to the right side 4c of the lower end of the slit nozzle 4, the discharge opening 4b of the slit nozzle 4, and the left side 4a of the lower end of the silt nozzle 4 in this order.

Paragraph [035]

FIGS. 5(a) and 5(b) shows a cleaning apparatus for a nozzle according to a second embodiment of the present invention. In FIGS. 5(a) and 5(b), the same elements as in FIGS. 1(a) – (c) have the same reference number, and the explanations thereof are omitted. In the embodiment shown in FIGS. 5(a) and 5(b), the slit nozzle 4 is cleaned by using two long-length

brushes 3, 3'. The long-length brushes 3, 3' are rotated clockwise, and wrap the whole lower end of the slit nozzle 4 in a state of keeping in contact with the lower end of the slit nozzle 4. In this state, the discharge opening 4b of the slit nozzle 4 is cleaned by the long-length brushes 3, 3', and thereafter, the left side 4a and the right side 4c are cleaned by gradually moving the long-length brushes 3, 3' upward, leftward and rightward. It is also possible to clean the left side 4a and the right side 4c first by moving the long-length brushes 3, 3' downward, leftward and rightward, and then clean the discharge opening 4b of the slit nozzle 4. Incidentally, line b-b' in FIGS. 5(a) and 5(b) is an imaginary line for showing the reference position. Although both of the long-length brushes 3, 3' are rotated clockwise in the above-mentioned embodiment, it is possible to rotate the long-length brush 3 clockwise and the long-length brush 3' counterclockwise.

Paragraph [038]

Since the two long-length brushes are rotated and moved in the vertical direction and the horizontal direction in a state where the lower end of the nozzle to be cleaned is sandwiched between the two long-length brushes, it is possible to more efficiently clean both side surfaces of the discharge opening of the slit nozzle as well as the discharge opening itself with the long-length brushes always being in contact in the best positions. Specifically, in order to clean both side surfaces of the discharge opening, the long-length brush is brushes are moved in the horizontal direction and then elevated.

Paragraph [039]

In addition, by providing the brush cleaning means or combs 5 for scraping a material attached to the long-length brushes itself within the cleaning tank, it is possible to always keep the long-length brushes clean.

Paragraph [040]

Although there have been described above what are the present embodiments of the invention, it will be understood that variations and modifications may be made thereto without departing from the spirit or essence of the invention.